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Attorney Dkt. 99P7558US01

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Washington, D.C. 20231

Sir:

Transmitted herewith for filing patent application of:

Inventor(s): Jack Richardson Lorraine, Todd Matthew Answine, Dean Leigh Spiers

Title: Fuel Injector Mounting Arrangement

The enclosed is:

1 1 cover page;

2 A patent application including:

a) 20 pages of specification, claims and abstract; and

b) 4 sheets of informal drawings;

3 Power of Attorney

4 Declaration;

5 Assignment – Recordation cover sheet;

The filing fee has been calculated as shown below:

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BASIC FEE	XXXXXXXX	XXXXXXXXX	XXXXX	$760.
TOTAL CLAIMS	18 - 20 =		x 18.=	
INDEP CLAIMS	4 - 3 =	1	x 78.=	78.
*	MULTIPLE DEPENDENT CLAIM PRESENTED		+270.=	
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Date: 18 May 99

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APPLICATION FOR LETTERS PATENT OF THE UNITED STATES

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TITLE OF INVENTION: **FUEL INJECTOR MOUNTING ARRANGEMENT**

TO WHOM IT MAY CONCERN, THE FOLLOWING IS
A SPECIFICATION OF THE AFORESAID INVENTION

FUEL INJECTOR MOUNTING ARRANGEMENT

CROSS-REFERENCE TO RELATED APPLICATION

This application expressly claims the benefit of earlier filing date and right of priority from the following co-pending patent application: U.S. Provisional Application U.S. Serial No. 60/_____, (Attorney Docket 99P7558US), entitled "Fuel Injector Mounting Arrangement" filed 20 April 1999. The cited patent application is expressly incorporated in its entirety by reference.

Background of the Invention

Particular fuel injection systems employ an air-assist system to encourage atomization of fuel that is metered out of a fuel injector into the air intake stream within an air induction device. In order to employ an air-assist system, the fuel injector needs to form operative seals with a plurality of structural members. In particular, the fuel injector needs to form at least one fuel seal and at least one atmosphere seal. The fuel seal being located between the fuel rail and the fuel injector. The atmosphere seal being located between the sub-atmospheric air in an air-assist passage of the air-assist system and the atmosphere air external to the air induction device.

A known manner of forming the atmosphere seal is to provide a face seal on the portion of the fuel injector installed in an aperture in the air induction device. The face seal engages and mates with a surface within the aperture to form the required atmosphere seal when an axial load is applied to the fuel injector. To apply the axial load, fuel pressure is applied to the fuel injector, which axial moves the fuel injector. In order to achieve this axial movement, fuel injectors in known systems are positioned proximate the fuel rail without being secured to the fuel rail.

Summary of the Invention

Applicants have discovered that at least three primary problems result due to the non-secured arrangement of the fuel injector to the fuel rail. First, during production of the fuel rail and fuel injector assembly, an alternate method must be found to retain the injectors for pressure (leak) testing on the production.

Second, during shipping and handling, fuel injectors separate from the fuel rail, which creates contamination and decreases product integrity. Thus, additional packaging must be developed to avoid this problem. Third, during final installation of the fuel injector and fuel rail assembly into a vehicle, a method must be developed to provide rotational positioning of the fuel injector for correct spray pattern alignment and/or electrical connector alignment. The identified problems are obviated by applicants novel mounting arrangement.

The present invention provides a mounting arrangement having a fuel rail; a fuel injector cup connected to the fuel rail, the fuel injector cup having a fuel communication area defining a longitudinal axis, a fuel rail mounting section, and a retaining surface; a fuel injector including a fuel metering end and a fuel inlet end, the fuel inlet end being exposed to the communication area; and a fastener that secures the fuel injector to the fuel injector cup and allows the fuel injector to reciprocate along the longitudinal axis of the fuel injector cup.

The fuel injector cup, preferably, comprises a cylindrical tube with a fuel rail mounting section being located at a first end of the tube, and the retaining surface being located at a second end of the tube. The retaining surface, preferably, comprises a lip located at the second end of cylindrical tube extending away from the longitudinal axis. he fuel injector comprises a housing

having a retention groove. The retention groove, preferably, comprises a channel that partially encircles the housing of the fuel injector. The fastener, preferably, comprises a clip having a wall and a pair of legs projecting from the wall. The pair of legs straddles both the fuel injector cup and the fuel injector. Each leg has a tab and a window. The tab has a mating surface that engages the channel of the fuel injector housing.

The mounting arrangement of the present invention also includes an air induction device having an aperture. The metering end of the fuel injector has a face seal that mates with the aperture when the fuel injector is located at one of the first position and the second position along the longitudinal axis.

The mounting arrangement of the present invention, preferably, comprises a production assembly having the clip installed by an automated process. The production assembly is capable of satisfying at least an appropriate assembly integrity test and environmental vibration test.

The present invention also provides a mounting arrangement with a fuel rail; a plurality of fuel injector cups connected to the fuel rail, each of the fuel injector cups including a cylindrical tube defining a longitudinal axis, a fuel rail mounting section disposed at a first end of the tube, and a lip at a second end of the tube; a plurality of fuel injectors, each fuel injector corresponding to one of the plurality of fuel injector cups , each fuel injector having a housing including a fuel metering end, a fuel inlet end, and a retention groove, the fuel inlet end of the fuel injector being disposed within the cylindrical tube of the fuel injection cup; and a clip that engages both the lip of the fuel injector cup and the retention groove in the housing of the fuel injector to secure the fuel injector to the fuel

injector cup and allow the fuel injector to reciprocate along the longitudinal axis extending through the cylindrical tube of the fuel injector cup.

The present invention also provides a clip that secures a fuel injector to a fuel injector cup on a fuel rail. The clip comprises a wall having a first end and a second end; a first leg projecting from the first end of the wall, the first leg including a first tab and a first window; and a second leg projecting from the second end of the wall, the first leg and the second leg being substantially parallel, the second leg including a second tab and a second window.

The first tab and the second tab of the clip have a corresponding mating surface configuration adapted to engage the retention groove in a housing of the fuel injector. The first window and the second window of the clip, each have a substantially similar frame adapted to engage a lip of the fuel injector cup. Each of the frames has a pair of landing edges extending along the corresponding leg. The pair of landing edges on each of the frames is spaced so that engagement of one of the landing edges with the lip of the fuel injector cup is exclusive of engagement of the lip of the fuel injector cup with the other of the landing edges.

The present invention also provides a method of mounting a fuel injector to a fuel injector cup on a fuel rail so that the fuel injector is secured to the fuel injector cup and the fuel injector can be positioned along a longitudinal axis defined by the fuel injector cup. The method comprises: providing a fuel rail with at least one fuel injector cup, the at least one fuel injector cup including a retaining surface; locating at least one fuel injector proximate the at least one fuel injector cup, the at least one fuel injector having a housing with a retention groove; and securing the at least one fuel injector to the at least one fuel injector

cup with a fastener that engages both the retention surface of the fuel injector cup and the retention groove in the housing of the fuel injector.

The method of the present invention also includes installing the clip with an automated process so that the at least one fuel rail, the at least one fuel injector, and the clip comprise a production assembly capable of satisfying at least an appropriate assembly integrity test and environmental vibration test.

Description of the Drawing Figures

The accompanying drawings, which are incorporated herein and constitute part of this specification, illustrate presently preferred embodiments of the invention, and, together with a general description given above and the detailed description of the preferred embodiments given below, serve to explain the principles of the invention.

Fig. 1 is a perspective view of the mounting arrangement of the present invention.

Fig. 2 is a perspective view of the fastener of the mounting arrangement of the present invention shown in Fig. 1.

Fig. 3 is a partial cross-sectional view of the mounting arrangement of the present invention proximate an air induction device in a non-operative position.

Fig. 4 is a partial cross-sectional view of the mounting arrangement of the present invention proximate an air induction device in an operative position.

Detailed Description of the Preferred Embodiment(s)

Fig. 1 illustrates the mounting arrangement 10 of the present invention. The mounting arrangement 10 includes a fuel rail 12, fuel injector cups 14 connected to a fuel rail 12, a plurality fuel injectors 16, and a fastener 18 for each fuel injector 16.

Each of the fuel injector cups 14 has a fuel communication area 20 defining a longitudinal axis 22, illustrated in Figs.3 and 4. The fuel injector cup is a cylindrical tube 24. The cylindrical tube 24 is formed from stamped metal. A fuel rail mounting section 26 is located at a first end 24a of the cylindrical tube 24 that mounts the fuel injector cup 14 to the fuel rail 12.

The fuel rail mounting section 26 is, preferably, brazed to the fuel rail 12, which is also metal. A retaining surface is located at a second end 24b of the cylindrical tube 24. The retaining surface, preferably, comprises a lip 28 extending away from the longitudinal axis 22.

Each of the fuel injectors 16 includes a housing 30 having a fuel metering end 32 and a fuel inlet end 34. The fuel inlet end 32 is exposed to the communication area 20. An O-ring 36 is positioned on the housing 30 proximate the fuel inlet end 34. The O-ring 36 forms a fuel tight seal with an inner surface 24c of the cylindrical tube 24 of the fuel injector cup 14. The housing 30 of the fuel injector 16 is provided with a retention groove. In the preferred embodiment of the invention, the retention groove is a channel 38 that partially encircles the housing 30 of the fuel injector 16. The channel includes a first end 38a and a second end 38b.

Each fastener 18 secures a fuel injector 16 to a fuel injector cup 14 and allows the fuel injector 16 to reciprocate along the longitudinal axis 22 of the fuel

injector cup 14. The fastener 18, preferably, is a stamped metal spring clip. The clip 40 has a wall 42 and a pair of legs 44, 46 projecting from the wall. The pair of legs 44a, 44b straddles both the fuel injector cup 14 and the fuel injector 16.

The wall 42 has a first end 42a and a second end 42b. The pair of legs includes a first leg 44a and a second leg 44b. The first leg 44a projects from the first end 42a of the wall 42. The first leg including a first tab 46a and a first window 48a. The second leg 44b projects from the second end 42b of the wall 42. The second leg 46b includes a second tab 46b, and a second window 48b. The first leg 44a and the second leg 44b are substantially parallel.

Each of the first tab 46a and the second tab 46b has a mating surface 50a, 50b that engages the retention groove of the fuel injector housing. In the preferred embodiment of the invention, each of the tabs 46a, 46b has a mating surface 50a, 50b that corresponds to the channel 38 that serves the retention groove in the fuel injector housing 30. Each tab includes a stop 52a, 52b that abuts the first end 38a and the second end 38b of the channel 38, respectively, to constrain relative rotation between the fuel injector 16 and the fuel injector cup 14.

Each of the first window 48a and the second window 48b has a substantially similar frame 54a, 54b that engages the retention surface of the fuel injector cup. In the preferred embodiment of the invention, the frame 54a, 54b of each the first window 48a and the second window 48b is adapted to engage the lip 28 of the fuel injector cup 14, which serves as the retention surface. Each of the frames 54a, 54b has a pair of landing edges 56a (56a1, 56a2), 56b (56b1, 56b2) extending along the corresponding leg 44a, 44b.

The frame 54a, 54b of each of the legs 44a, 44b further includes a pair of side edges 58a, 58b between the landing edges 56a, 56b so that the frame 54a, 54b has a substantially rectangular configuration. Although a substantially rectangular configuration is used for the frame, it is to be understood that other configurations, such as an oval, could be employed as long as the employed configuration includes a pair of landing edges. Each of the pair of side edges 58a, 58b between the landing edges 56a, 56b has a length approximately half the length of one of the pair of landing edges 56a, 56b.

The pair of landing edges 56a, 56b on each of the frames 54a, 54b are spaced so that engagement of one of the landing edges of the pair of landing edges with the lip 28 of the fuel injector cup 14 is exclusive of engagement of the lip 28 of the fuel injector cup 14 with the other of the landing edges of the pair of landing edges.

For example, as shown in Fig. 3, when the fuel injector 16 is located at a first position 60 along the longitudinal axis 22, the lip 28 of the fuel injector cup 14 engages one of the pair of landing edges 56a1, 56b1 provided on each of the frames 54a, 54b. The landing edge 56a1 56ba furthest from the fuel rail 12. Alternatively, as shown in Fig. 4, when the fuel injector 16 is located at a second position 62 along the longitudinal axis 22, the lip 28 of the fuel injector cup 14 engages the other landing edge 56a2, 56b2 of the pair of landing edges 56a, 56b. The landing edge 56a2, 56b2 closest to the fuel rail.

The fuel injector 16 is located at the second position 62 along the longitudinal axis 22, from an axial load created by an applied fuel pressure. When in the second position 62, the fuel injector 16 applies the appropriate sealing load to a face seal 63 on the metering end 32 of the fuel injector 16 so

that the face seal 63 mates with an aperture 64 in an air induction device 65. The air induction device, preferably, comprises a manifold with an air assist passage 66.. The manifold includes a head pocket that serves as the aperture.

Prior to installation of the mounting assembly in a vehicle proximate an air induction device, the fuel injector 16 can reciprocate along the longitudinal axis 22, such that the lip 28 of the fuel injector cup 14 engages either of the landing edges 56a1, and 56b1, or 56a2, and 56b2 of the pair of landing edges 56a, 56b. Although the fuel injector 16 is free to move along the longitudinal axis, the fuel injector 16 remains secured to the fuel injector cup 14 due to the engagement of the first tab 46a and the second tab 46b with the channel 38 of the fuel injector housing 30.

The mounting arrangement 10 comprises a production assembly having the clip 40 installed by an automated process. For implementation of the automated clip installation process, the clip 40 is manually installed onto the fuel injector housing 30 so that the first tab 46a and the second tab 46b engage the channel 38. After the clips 40 are installed on the fuel injectors 16, the fuel injectors 16 are placed into pockets attached to air cylinders. The number of pockets of the air cylinder corresponds to the number of fuel injector cups 14 located on the fuel rail 12. The fuel rail 12 is lubricated and clamped to a fixture at a fuel injector insertion station.

Once the fuel rail 12 and fuel injectors 16 are in place, the air cylinders are actuated to push the fuel injectors 16 by their associated clip 40 into the fuel injector cups on the fuel rail 12. During automated installation, the clip 40 springs open and stretches over the lip 28 of the fuel injector cup 14, and snaps closed as the frame 54a, 54b of the window 48a, 48b passes over the

lip 28 of the fuel injector cup 14. After the clip 40 is closed, the air cylinders retract while pulling on the clips 40 to ensure that the clips 40 have been installed properly. That is, the first frame 54a and the second frame 54b have engaged the lip 28 of the fuel injector cup 14.

Then the fuel rail is situated such that the fuel injectors are allowed to hang freely and the assembly is subjected to production assembly testing. This testing also verifies that the clip has fully engaged both the fuel injector and the fuel injector cup. If the clip was not properly installed, the clip would be thrown off the production assembly during testing, and the assembly would fail the appropriate production assembly test.

The production assembly is capable of satisfying at least an appropriate assembly integrity test and environmental vibration test. The assembly integrity test includes: (1) an air leakage test in which the production assembly must have an air leakage rate of no greater than 2.5 cc/min when the production assembly is pressurized to no greater than 600 kPa; and (2) a liquid immersion test in which the production assembly when at a stable pressure of no greater than 500 kPa and submerged in a test fluid for 30 seconds no bubbles appear in the test fluid.

The environmental vibration test includes, while vibrating the production assembly for a minimum of 15 hours in a longitudinal, lateral, and vertical direction at varying frequencies no greater than 600 Hz sinusoidal, subjecting the production assembly to at least: (1) a thermal cycle test over a range of approximately -40 to 140°C; and (2) a pressure cycle test of at least 30,000 cycles over a range of approximately 0 to 1500 kPa.

The present invention also includes a method of mounting the fuel injector to the fuel injector cup on a fuel rail so that the fuel injector is secured to the fuel injector cup and the fuel injector can be positioned along a longitudinal axis defined by the fuel injector cup. The method is achieved by providing a fuel rail with at least one fuel injector cup, the at least one fuel injector cup including a retaining surface; locating at least one fuel injector proximate the at least one fuel injector cup, the at least one fuel injector having a housing with a retention groove; and securing the at least one fuel injector to the at least one fuel injector cup with a fastener that engages both the retention surface of the fuel injector cup and the retention groove in the housing of the fuel injector.

The method further includes installing the clip with an automated process so that at least one fuel rail, and at least one fuel injector, and the clip comprise a production assembly capable of satisfying at least an appropriate assembly integrity test and environmental vibration test.

The foregoing preferred embodiments have been shown and described for the purposes of illustrating the structural and functional principles of the present invention, as well as illustrating the methods of employing the preferred embodiments and are subject to change without departing from such principles. Therefore, this invention includes all modifications encompassed within the spirit of the following claims.

CLAIMS

1. A mounting arrangement, comprising:

a fuel rail;

a fuel injector cup connected to the fuel rail, the fuel injector cup having a fuel communication area defining a longitudinal axis, a fuel rail mounting section, and a retaining surface;

a fuel injector including a fuel metering end and a fuel inlet end, the fuel inlet end being exposed to the communication area; and

a fastener that secures the fuel injector to the fuel injector cup and allows the fuel injector to reciprocate along the longitudinal axis of the fuel injector cup.

2. The mounting arrangement of claim 1, wherein the fuel injector cup comprises a cylindrical tube, the fuel rail mounting section being located at a first end of the tube, the retaining surface being located at a second end of the tube; and

wherein the fuel injector comprises a housing having a retention groove.

3. The mounting arrangement of claim 2, wherein the fastener comprises a clip having a wall and a pair of legs projecting from the wall, the pair of legs straddling both the fuel injector cup and fuel injector, each leg having a tab and a window, the tab having a mating surface that engages the retention groove of the fuel injector housing, the window having a frame that engages the retaining surface of the fuel injector cup.

4. The mounting arrangement of claim 3,

wherein the retaining surface comprises a lip located at the second end of cylindrical tube, the lip extending away from the longitudinal axis;

wherein the frame comprises a pair of landing edges configure so that, when the fuel injector is located at a first position along the longitudinal axis, the lip of the fuel injector cup engages one of the landing edges, and when the fuel injector is located at a second position along the longitudinal axis, the lip of the fuel injector cup engages the other of the pair of landing edges.

5. The mounting arrangement of claim 4,

wherein the retention groove comprises a channel that partially encircles the housing of the fuel injector, the channel including a first end and a second end;

wherein each of the tabs on each of the legs include a stop that abuts the first end and the second end of the channel, respectively, to constrain relative rotation between the fuel injector and the fuel injector cup.

6. The mounting arrangement of claim 5, further comprising an air induction device having an aperture, the metering end of the fuel injector comprising a face seal that mates with the aperture when the fuel injector is located at one of the first position and the second position along the longitudinal axis.

7. The mounting arrangement of claim 6, wherein the mounting arrangement comprises a production assembly having the clip installed by an automated process, the production assembly being capable of satisfying at least an appropriate assembly integrity test and environmental vibration test.

8. A mounting arrangement, comprising:

a fuel rail;

a plurality of fuel injector cups connected to the fuel rail, each of the fuel injector cups including a cylindrical tube defining a longitudinal axis, a fuel rail mounting section disposed at a first end of the tube, and a lip at a second end of the tube;

a plurality of fuel injector, each fuel injector corresponding to one of the plurality of fuel injector cups, each fuel injector having a housing including a fuel metering end, a fuel inlet end, and a retention groove, the fuel inlet end of the fuel injector 16 being disposed within the cylindrical tube of the fuel injection cup; and

a clip that engages both the lip of the fuel injector cup and the retention groove in the housing of the fuel injector to secure the fuel injector to the fuel injector cup and allow the fuel injector to reciprocate along the longitudinal axis extending through the cylindrical tube of the fuel injector cup.

9. The mounting arrangement of claim 8, wherein the clip comprises a wall and a pair of legs projecting from the wall, the pair of legs straddling both the fuel injector cup and fuel injector, each leg having with a tab and a widow, the tab having a mating surface that engages the retention groove in the housing of

the fuel injector, the window having a frame that engages the lip of the fuel injector cup, the frame having a pair of landing edges extending along the corresponding leg, the pair of landing edges on the frame configured so that, when the injector is located at a first position along the longitudinal axis, the lip of the fuel injector cup engages one of the landing edges, and when the injector is located at a second position along the longitudinal axis, the lip of the fuel injector cup engages the other of the pair of landing edges.

10. The mounting arrangement of claim 9,

wherein the mounting arrangement comprises a production assembly having the clip installed by an automated process;

wherein the production assembly is capable of satisfying at least an appropriate assembly integrity test and environmental vibration test.

11. The mounting arrangement of claim 10,

wherein the assembly integrity test includes: (1) an air leakage test in which the production assembly must have an air leakage rate of no greater than 2.5 cc/min when the production assembly is pressurized to no greater than 600 kPa; and (2) a liquid immersion test in which the production assembly when at a stable pressure of no greater than 500 kPa and submerged in a test fluid for 30 seconds no bubbles appear in the test fluid; and

wherein the environmental vibration test includes, while vibrating the production assembly for a minimum of 15 hours in a longitudinal, lateral, and vertical direction at varying frequencies no greater than 600 Hz sinusoidal, subjecting the production assembly to at least: (1) a thermal cycle test over a range of

approximately -40 to 140°C; and (2) a pressure cycle test of at least 30,000 cycles over a range of approximately 0 to 1500 kPa.

12. A clip for securing a fuel injector to a fuel injector cup on a fuel rail, the fuel injector having a housing with a retention groove, and the fuel injector cup having a lip, the clip comprising:

a wall having a first end and a second end;

a first leg projecting from the first end of the wall, the first leg including a first tab and a first window; and

a second leg projecting from the second end of the wall, the first leg and the second leg being substantially parallel, the second leg including a second tab and a second window;

wherein the first tab and the second tab have a corresponding mating surface configuration adapted to engage the retention groove in the housing of the fuel injector; and

wherein the first window and the second window each have a substantially similar frame adapted to engage the lip of the fuel injector cup, each of the frames having a pair of landing edges extending along the corresponding leg, the pair of landing edges on each of the frames being spaced so that engagement of one of the landing edges with the lip of the fuel injector cup is exclusive of engagement of the lip of the fuel injector cup with the other of the landing edges.

13. The clip of claim 12, wherein the frame of each of the legs further includes a pair of side edges between the landing edges so that the frame has a substantially rectangular configuration.

14. The clip of claim 13, wherein the frame of each of the legs further includes a pair of side edges between the landing edges, each of the side edges having a length approximately half the length of one of the landing edges.

15. A method of mounting a fuel injector to a fuel injector cup on a fuel rail so that the fuel injector is secured to the fuel injector cup and the fuel injector can be positioned along a longitudinal axis defined by the fuel injector cup, the method comprising:

providing a fuel rail with at least one fuel injector cup, the at least one fuel injector cup including a retaining surface;

locating at least one fuel injector proximate the at least one fuel injector cup, the at least one fuel injector having a housing with a retention groove; and

securing the at least one fuel injector to the at least one fuel injector cup with a fastener that engages both the retention surface of the fuel injector cup and the retention groove in the housing of the fuel injector.

16. The method of claim 15, further comprising:

providing a lip on the fuel injector cup as the retaining surface and a channel partial encircling the housing of the fuel injector as the retaining groove; and

providing a metal clip as the fastener, the clip comprising a wall and a pair of legs projecting from the wall, the pair of legs straddling both the fuel injector cup and fuel injector, each leg having with a tab and a window, the tab having a mating surface that engages the channel in the housing of the fuel injector, the window having a frame that engages the lip of the fuel injector cup, the frame having a pair of landing edges extending along the corresponding leg, the pair of landing edges on the frame configured so that, when the fuel injector is located at a first position along the longitudinal axis, the lip of the fuel injector cup engages one of the landing edges, and when the fuel injector is located at a second position along the longitudinal axis, the lip of the fuel injector cup engages the other of the pair of landing edges.

17. The method of claim 16, further comprising:

installing the clip with an automated process so that the at least one fuel rail, the at least one fuel injector, and the clip comprise a production assembly capable of satisfying at least an appropriate assembly integrity test and environmental vibration test.

18. The method of claim 18, further comprising:

providing an air induction device having an aperture so that a face seal on a metering end of the fuel injector mates with the aperture when the fuel injector is located at one of the first position and the second position along the longitudinal axis.

Abstract

A mounting arrangement with a fuel rail having a plurality of fuel injector cups, a plurality of fuel injectors, and a clip. The fuel injector cups include a cylindrical tube defining a longitudinal axis, a fuel rail mounting section disposed at a first end of the tube, and a lip at a second end of the tube. Each of the fuel injectors corresponding to one of the plurality of fuel injector cups. The fuel injectors have a housing with a retention groove. The clip engages both the lip of the fuel injector cup and the retention groove in the housing of the fuel injector to secure the fuel injector to the fuel injector cup and allow the fuel injector to reciprocate along the longitudinal axis.

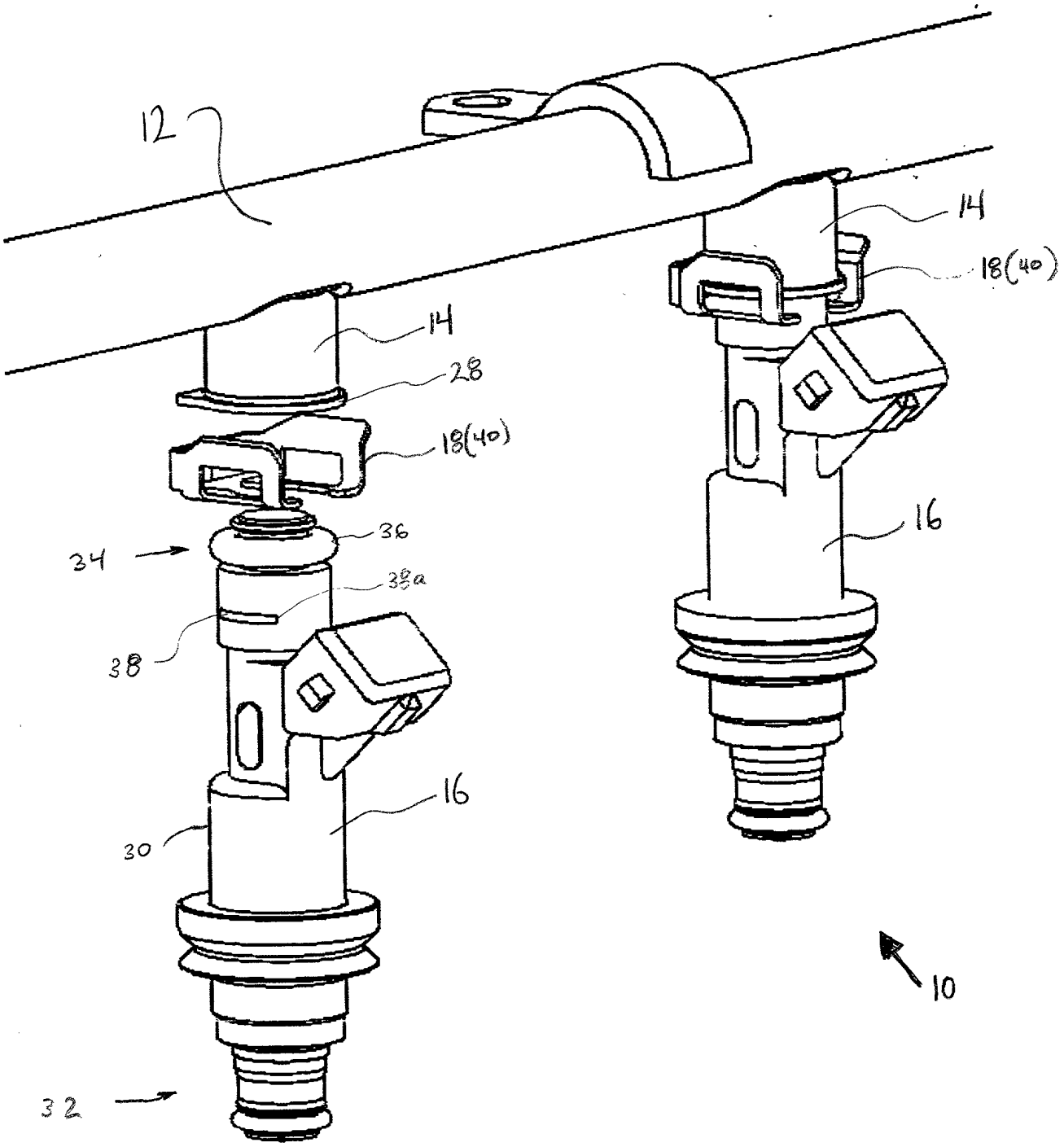

FIG. 1

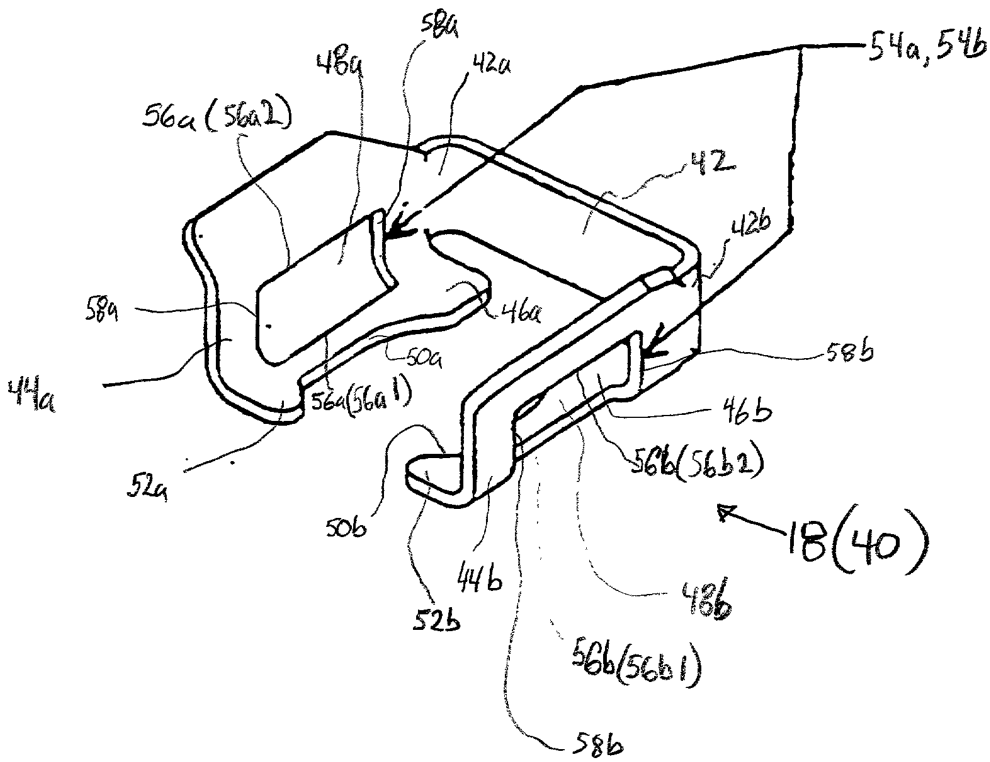
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FIG. 2

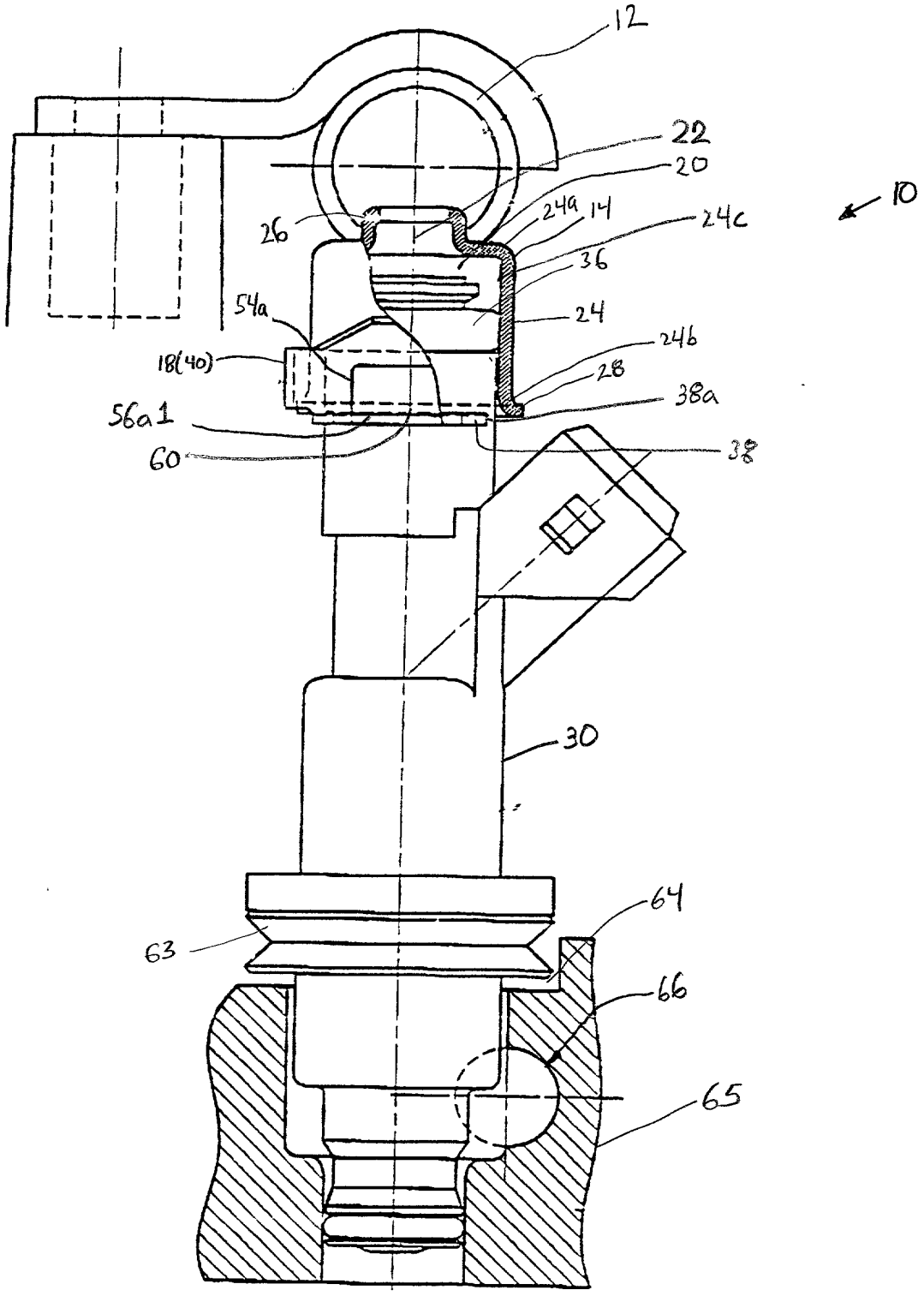
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FIG. 3

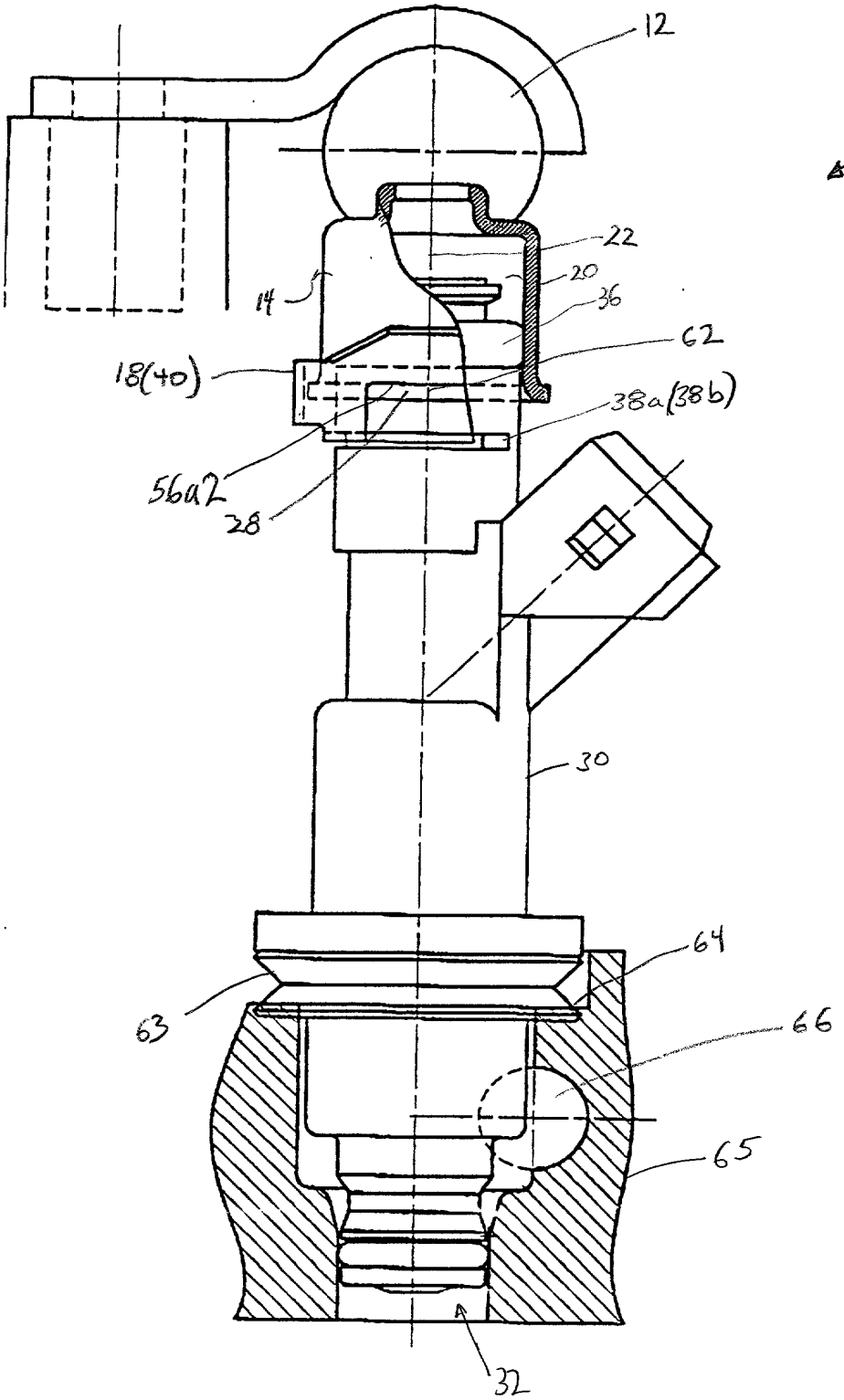

FIG. 4

Express Mail TB 718 171 630US Attorney Dkt. 99P7558US01

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Title: Fuel Injector Mounting Arrangement

POWER OF ATTORNEY AND
DESIGNATION OF CORRESPONDENCE ADDRESS

As Assistant Secretary, Intellectual Property, of Siemens Automotive Corporation, assignee of this application, I hereby appoint the following attorneys employed by Siemens Corporation to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith:

Adel A. Ahmed Reg. No. 29,606	Jeffrey P. Morris Reg. No. 25,307	Peter A. Luccarelli Jr. Reg. No. 29,750	Ira Lee Zebrak Reg. No. 31,147
Robert T. Canavan Reg. No. 37,592	Lawrence C. Edelman Reg. No. 29,299	Joseph S. Codispoti Reg. No. 31,819	David W. Laub Reg. No. 38,708
Aaron C. Deditch Reg. No. 33,865	Donald B. Paschburg Reg. No. 33,753	Mark H. Jay Reg. No. 27,507	Jeff Slusher Reg. No. 34,729
Darryl A. Smith Reg. No. 37,723	Robert A. Whitman Reg. No. 36,966	Stanton C. Braden Reg. No. 32,556	Heather S. Vance Reg. No. 39,033
Scott T. Weingaertner Reg. No. 37,756	Rosa S. Kim Reg. No. 39,728	Daniel J. Staudt Reg. No. 34,733	Laura M. Slenzak Reg. No. 35,363

Send Correspondence to:
Elsa Keller
Intellectual Property Department
Siemens Corporation
186 Wood Avenue South
Iselin, New Jersey 08830

Direct Telephone Calls to:
Elsa Keller
(732) 321-3026

I hereby declare and certify that I am Assistant Secretary, Intellectual Property as set forth above and am empowered to make the above appointment, that the assignee's ownership of this patent application is established by the attached assignment documentation, that the attached documentation is a true copy of the original documentation, that the original or a true copy of the attached documentation has been or is concurrently being submitted to the Patent and Trademark Office for recording, that the attached documentation has been reviewed, and that to the best of the assignee's knowledge and belief, title is in the assignee seeking to take the action. I further declare that the foregoing statements made of my own knowledge are true and that all statements made on information and belief are believed to be true and made with the understanding that willful false statements and the like are punishable by fine or imprisonment, or both, under title 18 United States Code §1001 and may jeopardize the validity of this application or any patent issuing thereon.

SIEMENS AUTOMOTIVE CORPORATION

Date: 18 MAY 1999

By: Peter A. Luccarelli Jr.
Name: Peter A. Luccarelli Jr.
Assistant Secretary, Intellectual Property

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DECLARATION FOR PATENT APPLICATION AND DESIGNATION OF CORRESPONDENCE ADDRESS

As below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name,

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

FUEL INJECTOR MOUNTING ARRANGEMENT

the specification of which (check one)

_X_ is attached hereto.

____ was filed on _____ as Application Serial No. _____ and was amended on _____ (if applicable).

I hereby state that I have reviewed and understand the contents of the above-identified specification including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to the examination of this application in accordance with 37 CFR §1.56(a).

PRIOR FOREIGN/PCT APPLICATION(S) FILED WITHIN 12 MONTHS (6 MONTHS FOR DESIGN) PRIOR TO THIS APPLICATION AND ANY PRIORITY CLAIMS UNDER 35 U.S.C. § 119(a)-(d)

I hereby claim foreign priority benefits under 35 USC §119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

Prior Foreign Application(s)			Priority Claimed	
Number	**Country**	**Day/Month/Year Filed**	**Yes**	**No**

CLAIM FOR BENEFIT OF PRIOR U.S. PROVISIONAL APPLICATION(S) (34 U.S.C. § 119(e))

I hereby claim the benefit under Title 35, United States Code, § 119(3) of any United States provisional application(s) listed below:

Provisional Application Number	Filing Date
60/	20 April 1999

CLAIM FOR BENEFIT OF EARLIER US/PCT APPLICATION(S) UNDER 35 U.S.C. 120

I hereby claim the benefits under 35 USC §120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of 35 USC §112, I acknowledge the duty to disclose material information as defined in 37 CFR §1.56(a) which occurred between the filing date of the prior application and the national or PCT international filing date of this application:

Appl. No.	Filing Date	Status	Patented, Pending, Abandoned

Send Correspondence to:
Elsa Keller, Legal Assistant
Intellectual Property Department
SIEMENS CORPORATION
186 Wood Avenue South
Iselin, New Jersey 08830
Tel. No. (732) 321-3026

I hereby declare that all statements made herein on my own knowledge are true and that all statements made on information and belief are believed to be true, and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both under 18 USC §1001 and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

Full Name of Sole
or First Inventor: Jack Richardson Lorraine

Inventor's Signature ______ Date: 5/17/99

Residence: 113 Jones Road, Newport News, Virginia 23601, USA

Citizenship: USA

Post Office Address: 113 Jones Road, Newport News, Virginia 23601, USA

Full Name of Second Joint
Inventor, if any: Todd Matthew Answine

Inventor's Signature ______ Date: 5/17/99

Residence: 602 Crown Point Drive, Newport News, Virginia 23602, USA

Citizenship: USA

Post Office Address: 602 Crown Point Drive, Newport News, Virginia 23602,

---

Full Name of Third Joint
Inventor, if any: Dean Leigh Spiers

Inventor's Signature ______ Date: 5/17/99

Residence: 102 Sheffield Lane, Yorktown, Virginia 23692, USA

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